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IDENTIFICATION AND EVALUATION OF OPERATIONAL ALTERNATIVES FOR MATERIALS DATA BANK

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16. Abstract

A review of the organization and operation of the Urban Mass Transportation Administration's Materials Data Bank is presented.

Alternatives to the current system of Data Bank Operation are identified and evaluated.

It is recommended that the best method for managing and disseminating the technical data will be accomplished via the Transportation Systems Center.

A notice of the availability of this system will be published in the Federal Register.

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PREFACE

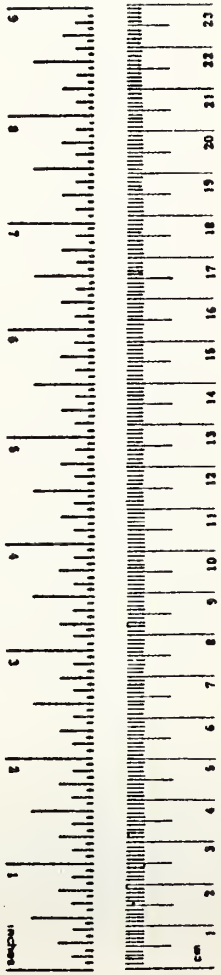
The Urban Mass Transportation Administration (UMTA) has expended considerable effort in assessing the fire performance characteristics of materials used in transit vehicles. The collection and dissemination of pertinent flammability information are an important part of this research. In this document the computerized materials flammability data system is described; its benefits to potential users are assessed and recommendations to improve its accessibility are presented.

The authors wish to thank William J. Rhine and Robert I. Haught, for valuable guidance and comments. They also wish to acknowledge the support and contributions of James M. Peterson, Boeing Commercial Airplane Company.

METRIC CONVERSION FACTORS

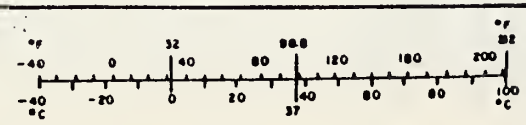
Approximate Conversions to Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
	LENGTH			
in	inches	2.5	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6	kilometers	km
	AREA			
in^2	square inches	6.5	square centimeters	cm^2
ft^2	square feet	0.09	square meters	m^2
yd^2	square yards	0.8	square meters	m^2
mi^2	square miles	2.6	square kilometers	km^2
	acres	0.4	hectares	ha
	MASS (weight)			
oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
	short tons (2000 lb)	0.9	tonnes	t
	VOLUME			
tsp	teaspoons	5	milliliters	ml
Tbsp	tablespoons	15	milliliters	ml
fl oz	fluid ounces	30	milliliters	ml
c	cups	0.24	liters	l
pt	pints	0.47	liters	l
qt	quarts	0.95	liters	l
gal	gallons	3.8	liters	l
ft^3	cubic feet	0.03	cubic meters	m^3
yd^3	cubic yards	0.76	cubic meters	m^3
	TEMPERATURE (exact)			
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C



Approximate Conversions from Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
	LENGTH			
mm	millimeters	0.04	inches	in
cm	centimeters	0.4	inches	in
m	meters	3.3	feet	ft
m	meters	1.1	yards	yd
km	kilometers	0.6	miles	mi
	AREA			
cm^2	square centimeters	0.16	square inches	in^2
m^2	square meters	1.2	square yards	yd^2
km^2	square kilometers	0.4	square miles	mi^2
ha	hectares (10,000 m^2)	2.5	acres	
	MASS (weight)			
g	grams	0.035	ounces	oz
kg	kilograms	2.2	pounds	lb
t	tonnes (1000 kg)	1.1	short tons	
	VOLUME			
ml	milliliters	0.03	fluid ounces	fl oz
l	liters	2.1	pints	pt
l	liters	1.06	quarts	qt
l	liters	0.26	gallons	gal
m^3	cubic meters	35	cubic feet	ft^3
m^3	cubic meters	1.3	cubic yards	yd^2
	TEMPERATURE (exact)			
°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F



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15. Supplementary Notes

16. Abstract

The Urban Mass Transportation Administration (UMTA) has expended considerable effort in assessing the fire performance characteristics of materials used in transit vehicles. The collection and dissemination of pertinent flammability information are an important part of this research. The large volume of data associated with the flammability characteristics necessitated the establishment of a system for storing the data in such a manner that it would be easily available upon request. In the past, a request for such data required a search of files, journal articles, and manufacturers' literature. To address these problems, a plan for a computerized information storage and retrieval system was devised to accomodate such data queries. This report is intended to provide a review of the organization and operation of UMTA's Materials Data Bank which was established and is maintained by the Transportation Systems Center (TSC). Contained within the Materials Data Bank are two basic categories of information: 1) non-metallic materials flammability data and 2) fire extinguisher data. Included in this review are the reasons for the Bank's establishment, details of its contents, present operational status, and the identification and evaluation of operational alternatives directed at improving its visibility and its usefulness to the technical community.

It is recommended that the best method for managing and disseminating the technical data will be accomplished through TSC. A notice of the availability of this system will be published in the Federal Register.

17. Key Words	18. Distribution Statement
Combustible Materials; Computerized Data Bank; Data Bank; Fire Extinguisher Data; Flammability; Materials Data Bank; Non-Metallic Materials Flammability Data	Available to the public through the National Technical Information Service, Springfield, Virginia 22161.

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1. INTRODUCTION

This report is intended to provide a review of the organization and operation of the Urban Mass Transportation Administration's (UMTA) Materials Data Bank established and maintained by the Transportation Systems Center (TSC). Included in this review are the reasons for its establishment, details of the data bank contents, present operational status, and the identification and evaluation of a series of operational alternatives directed at improving its visibility and its usefulness to the technical community. Resulting from this review are a series of recommendations for implementation of a system for enhancing the usefulness of the Materials Data Bank.

BACKGROUND

The Materials Data Bank was developed in support of the UMTA fire safety program. A part of this fire safety program is directed at the flammability characteristics of the materials used in transit systems and has resulted in the development of guidelines for these characteristics. The large volume of data associated with these flammability characteristics necessitated the establishment of a system for storing the data in such a manner that it would be easily available upon request. In the past a request for such data required a search of files, journal articles and manufacturers' literature. The comparison of flammability data on several materials was an even more arduous task. To address these problems a plan for a computerized information storage and retrieval system was devised to accommodate such data queries. To implement this plan, a contract was awarded to the Boeing Commercial Airplane Company on November 1, 1974 (DOT-TSC-926), and initial work was completed eight months later. An additional contract was awarded to the Boeing Co. in April 1978 (DOT-TSC-1534) for the purpose of updating the system, modifying the software program and adding data.

2. DATA BANK ORGANIZATION AND OPERATION

Contained within the Materials Data Bank are two basic categories of information: (1) non-metallic materials flammability data and (2) fire extinguisher data. The materials data stored in the bank addresses the following data types: (1) Materials Descriptions, (2) Materials Data and (3) Data Source Identification. The fire extinguisher data stored in the bank addresses the following data types: (1) type of fire on which specific extinguishers can be used, (2) extinguishing agent type and (3) toxicity of agent. As the fire extinguisher data is at present quite limited, this report addresses only the category of non-metallic materials flammability data.

2.1 DATA BANK ORGANIZATION

The design of the data bank (see Reference 1)* allows for storage and rapid retrieval of the desired data. The structure of the data bank was determined by the requirement that it should house and allow ready access to materials properties needed for designing a variety of items used in transit systems (seats, wall and ceiling panels, flooring, etc.).

Three separate types of information are stored for each material:

Materials identifiers (which identify the material by its manufacturer's designation, materials type, materials use, etc.).

Identification of data sources or where the data was obtained (report number, etc.).

Materials data and the test methods and results.

This information provides a comprehensive data base for use by system designers, planners, and regulatory officials concerned with operational safety.

2.1.1 Materials Identifiers

The materials are identified by manufacturer, commercial designation, material utilization, material type (form), and material composition.

The manufacturer and associated commercial designation are entered in the data bank in their entirety or suitably abbreviated to fit the allotted space.

Material utilization (component type, i.e. flooring, wall), and material composition are all entered in coded form. The use of codes permits conservation of computer storage and simplification of input. A large number of codes have been provided for these items. New codes can be entered by the programmer to cover those materials aspects not previously included. The component use type categories and codes consist of the following:

Component Use Type	Component Use Type Code
ADHESIVE	AD
ACOUSTICAL INSULATION	AI
CEILING PANELS	CP
CARPET	CT
DRAPERIES/CURTAINS	DP
ELECTRICAL INSULATION	EI
ELECTRICAL WIRE	EW
FLOORING	FL
GLASS WINDOWS	GW
LIGHTING DIFFUSERS	LD
LINERS	LR
PLASTIC WINDOWS	PW
SEAT CUSHIONS	SC

*1. Boeing Commercial Airplane Co., "Transportation System Center Material Data Bank User's Manual," DOT-TSC-1534-2, Nov. 1978. Material on File.

Component Use Type	Component Use Type Code
SEAT FRAMES	SF
THERMAL INSULATION	TI
UPHOLSTERY	UP
WALL PANELS	WP
PANELS, NOT OTHERWISE CLASSIFIED	XP
OTHER COMPONENTS	XX
NOT SPECIFIC	YY

An example of the procedure utilized in interpreting the materials identifiers' codes is shown below.

Manufacturer's Designation	Manufacturer	Component Use	Material Code
EPON 828/VERS^{R}	Shell Chem/ Gen Mills	YY	AEBLGS^{R}

This means that the material EPON 828/VERS 125, manufactured by Shell Chemical/General Mills, is not specific to any particular component (component use YY) and is a two-part, polyamide cured liquid epoxy adhesive (AEBLGS). Reference 1* provides more detail.

2.1.2 Identification of Data Sources

The data source is entered in the form of a report number, and the identification of the performing facility is entered in code. Several facilities have been identified as shown below and others may be added. Currently, the data are obtained principally from the FAA/NAFEC Fire Safety Branch and the materials testing area of the Boeing Company Chemical Technology Group. A limited amount of data comes from other sources, including material suppliers and their designated testing laboratories.

Data Source	Code
AIRRESEARCH MFG. CO.	AR
BOEING	BO
DOT/TSC	DT
ROCKWELL	FA
FLIGHT SAFETY OFFICE, MSC	FS
GAEC	GA
GENERAL MOTORS, AC ELECTRONICS DIVISION	GM
MCDONNELL - DOUGLAS	MD
NAFEC	NA
NATIONAL BUREAU OF STANDARDS	NB
NR/SD	NR
CREW SYSTEMS DIVISION JSC	PL
UNITED STATES TESTING CO.	US
VENDOR	VR
WHITE SANDS	WS

At present data from NASA's Non-Metallic Materials Design Guidelines Test Handbook are not included for two reasons: (1) The NASA test procedures are standard only to NASA, and (2) The test environments are at other than atmospheric pressure or at other than the normal oxygen/nitrogen ratio.

2.1.3 Materials Data

The data bank has been designed so that a broad variety of materials data acquired by different test methods can be stored. Test types include flame spread indices; smoke emission; toxic gas evolution; chemical, physical, mechanical and electrical properties; and maintainability and durability. Cost has not been included because of the difficulty in updating. The Appendix contains a complete listing of all the test types, their respective test codes and the test measurements for each test type. The data required to describe the results of a test normally consist of more than one measurement, so for each type of test, there may be several measurements taken; these measurements may be either test parameters or test results. With the present design of the data bank, it is possible to store up to twelve measurements

*1. op. cit.

for each type of test. This provides the system with its unique versatility, since each of the twelve measurements contains a piece of information such as the example shown below:

F14	ASTM E 162:MATL SURFACE FLAMM USING RADIANT ENERGY
F14A	MATERIAL THICKNESS
F14B	NUMBER OF SPECIMENS
F14C	FLAME SPREAD FACTOR F_s
F14D	STANDARD DEVIATION OF FLAME SPREAD FACTOR F_s
F14E	HEAT EVOLUTION FACTOR Q
F14F	STANDARD DEVIATION OF HEAT EVOLUTION FACTOR Q
F14G	FLAME SPREAD INDEX I_s
F14H	STANDARD DEVIATION OF FLAME SPREAD INDEX I_s

The test code F14 is the ASTM E162 test for material surface flammability using a radiant energy source. The codes F14A thru F14H refer to eight measurements that may be used to fully describe the test and its results. Although it is possible to make up to twelve measurements with each test only eight are used in conjunction with the ASTM E162 test.

Individual materials may be retrieved by the use of an assigned identification number. For comparison purposes, groups of materials may be retrieved based on a variety of categories, for example, by specific manufacturer, chemical composition, test procedure, data source, or use category. Moreover, the items may be retrieved by specific upper and lower values of test data in ascending or descending order.

In summary, the following items are included under the following identifiers:

Manufacturer's Designation

Manufacturer

Component Use

Material Type and Composition

Flame Spread Index

Smoke Evolution

Toxic Gas Evolution

Physical, Mechanical and Electrical Properties

Chemical Properties

Maintainability and Durability.

Test results are listed by the particular test procedure that was used as well as the testing organization and the date of the test. The data are available in the English system or in the equivalent metric system. Periodically, test data are forwarded to product manufacturers for review.

2.2 DATA BANK OPERATION

The operation of the data bank from a user's point of view is described by Reference 1,* an unpublished User's Manual, DOT-TSC-1534-2, Section 4. The detailed software construction is described by Reference 2,** an unpublished Programmer's Manual, DOT-TSC-1534-1. Principal features of the data bank operation are described in the following sections.

The data bank is operated on the TSC DEC System 10 computer and utilizes the resident System 1022 software. The computer is accessed from teletype-compatible

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* 1. op. cit.

**2. Boeing Commercial Airplane Co., "Transportation Systems Center Materials Data Bank Programmer's Manual," DOT-TSC-1534-1, Jan. 1979. Material on file.

terminals currently available at TSC (such as the Hazeltine 2000 or the CID 1030, both of which have hard copy printed output capabilities). The data bank is protected from unauthorized usage by System 1022 software passwords and, at present, is accessible only from TSC and the Boeing Commercial Airplane Co.

Three logical groups of data manipulation capabilities are provided in the data bank design:

Data retrieval

Display and Printout of Data

Maintenance of Data.

2.2.1 Data Retrieval

The data bank is accessible on TSC computing equipment in a conversational mode to personnel with a minimal background in computers.

An inquirer seeking information from the data bank is requested by the computer to respond to a series of questions, which the computer uses to identify and recall the appropriate data. The data are then displayed at the terminal. Data from several materials or an entire category of materials can be arranged using simple and appropriate conversational commands to the computer, to rank materials in either increasing or decreasing order of merit. Such ranking can be done on the basis of any of several criteria (each generally the result of a test type), so that design tradeoffs can be effected. With this ability it is then possible to select all the materials within a particular component category and to arrange them on the basis of certain fire test result priorities. Figure 1 shows an example where several carpet materials were ranked in the data bank printout according to their critical radiant heat flux (meas. #2).

2.2.2 Display and Printout of Data

After the desired set of data has been identified and selected, the values of the data can be displayed immediately at the terminal. One feature which should be emphasized is the user's ability to specify the order in which the data is displayed. Data may be sorted and displayed in several forms depending on the desired data use (see Section 2.2.1). A printed copy may then be obtained at the terminal printer or through the TSC computer center.

A high volume display capability has been provided so that a high-speed printer can be used when the entire data base or a selected set is to be displayed.

Figures 2 and 3 represent a sample of the type of printout available for a specific material. Displayed in the left column of both figures is the material identification number (MAT ID, BWP016). Each material in the data base has its own unique identification number. The remaining information in the Figures is self-explanatory.

2.2.3 Maintenance of Data

Maintenance involves deleting, changing, or adding new information to the data base. Maintenance operations are protected by special passwords. These operations allow a programmer to make alterations to any record in the data base. This may involve changing any data item for any record in the data base, adding records, and deleting records. Capability is also provided to add, change, or delete any of the test methods or materials identification codes.

For batch updating, the capability to add records that have been previously placed on a disk data set is provided. This can lessen the amount of typing required at the terminal if data to be added exist on computer readable media. Normally, some support from data processing personnel may be required to edit and reformat available data. See Section 2.3.2 of the Programmer's Manual (Reference 2) for a complete description of this capability.

MAT ID	MANUFACTURER'S DESIGNATION	MANUFACTURER	TEST METHOD	MEAS. # 2
TOT003	CARPET, FIBERGLASS/WOOL	CAROLINA NARROW FABRIC	F22	1.2000
TOT002	CARPET, FIBERGLASS/WOOL	CAROLINA NARROW FABRIC	F22	1.2000
TOT001	CARPET, FIBERGLASS/N	CAROLINA NARROW FABRICS	F22	1.1000
TOT004	CARPET, FIBERGLASS/WOOL	CAROLINA NARROW FABRIC	F22	1.1000
TOT008	LEVEL LOOP	LEES CARPET (No Underpad)	F22	0.9700
TOT015	CARPET	BURLINGTON IND. (LEES)	F22	0.7500
TOT016	CARPET	BURLINGTON IND. (LEES)	F22	0.7200
TOT014	CARPET	BURLINGTON IND. (LEES)	F22	0.6700
TOT013	CARPET	BURLINGTON (ND. (LEES)	F22	0.6600
TOT010	LOOP	COMMERCIAL CARPET CO. (No Underpad)	F22	0.5400
TOT006	VELVET	LEES CARPET	F22	0.2700
TOT009	LEVEL LOOP	LEES CARPET (With Under pad)	F22	0.2700
TOT007	VELVET	LEES CARPET	F22	0.1300
TOT011	LOOP	COMMERCIAL CARPET CO. (With Underpad)	F22	0.1000

FIGURE 1. CARPET MATERIAL RANKED ACCORDING TO CRITICAL RADIANT PANEL HEAT FLUX

D O T / T S C M A T E R I A L S D A T A B A N K REPORT FORMAT: 3A DATE: 13-Mar-80
(ENGLISH UNITS)

MAT ID	MANUFACTURER'S DESIGNATION	MANUFACTURER
BMP016	SHEET-MOLDING COMPOUND 9300-30	H

FIELD	CODE	INTERPRETATION
COMPONENT USE CODE	WP	WALL PANELS
MATERIAL TYPE CODE	AZ	COMPOUND, MOLDING
MATERIAL COMPOSITION 1	C8	POLYESTER, N.O.C.
MATERIAL COMPOSITION 2	FV	FIBERGLASS FABRIC

MAT ID	TEST METH CODE	TEST FAC CODE	DATA SOURCE CODE	TEST DATE	INTEGER OF IDENTIFICATION
BMP016	F00	B0		7/12/1978	1517

TEST PROCEDURE	TEST REPORT NUMBER	MISCELLANEOUS NOTES
FEDERAL AIR REGULATION 25, VERTICAL TESTS	BMT 78-00368	

TEST RESULT	UNIT OF MEASURE	TEST RESULT NAME
60.0000	SECONDS	IGNITION TIME
1.7000	SECONDS	SELF-EXTINGUISHING TIME, ISOTROPIC/WARP
1.8000	INCHES	BURNED LENGTH, ISOTROPIC/WARP
0.0000	SECONDS	DRIP EXTINGUISHING TIME, ISOTROPIC/WARP
1.9000	SECONDS	SELF EXTINGUISHING TIME, FILL
1.7000	INCHES	BURNED LENGTH, FILL
0.0000	SECONDS	DRIP EXTINGUISHING TIME, FILL

MAT ID	TEST METH CODE	TEST FAC CODE	DATA SOURCE CODE	TEST DATE	INTEGER OF IDENTIFICATION
BMP016	F14	B0		7/21/1978	1518

TEST PROCEDURE	TEST REPORT NUMBER	MISCELLANEOUS NOTES
ASTM E 162:MATL SURFACE FLAMM USING RADIANT ENERGY	BMT 78-00368	

TEST RESULT	UNIT OF MEASURE	TEST RESULT NAME
0.0750	INCHES	MATERIAL THICKNESS
4.0000		NUMBER OF SPECIMENS
2.8000		FLAME SPREAD FACTOR FS
1.4000		STANDARD DEVIATION OF FLAME SPREAD FACTOR FS
4.7000		HEAT EVOLUTION FACTOR Q
0.2000		STANDARD DEVIATION OF HEAT EVOLUTION FACTOR Q
13.2000		FLAME SPREAD INDEX IS
6.7000		STANDARD DEVIATION OF FLAME SPREAD INDEX IS

FIGURE 2. SAMPLE OF PRINT-OUT FORMAT NO. 1

D O T / T S C M A T E R I A L S D A T A B A N K REPORT FORMAT: 3A DATE: 13-Mar-80
(ENGLISH UNITS)

MAT ID	TEST METH CODE	TEST FAC CODE	DATA SOURCE CODE	TEST DATE	INTEGER OF IDENTIFICATION
BWP016	811	BO		8/ 1/1978	1519

TEST PROCEDURE: NATIONAL BUREAU OF STANDARDS SMOKE DENSITY CHAMBER
TEST REPORT NUMBER: BMT 78-00368
MISCELLANEOUS NOTES:

TEST RESULT	UNIT OF MEASURE	TEST RESULT NAME
0.0750	INCH	MATERIAL THICKNESS
2.5000	WATT/SQCM	THERMAL FLUX OF HEATER
13.1000		SPECIFIC OPTICAL DENSITY AT 1.5 MINUTE, FLAMING
5.1000		STD DEV DS AT 1.5 MINUTE, FLAMING
150.0000		SPECIFIC OPTICAL DENSITY AT 4.0 MINUTE, FLAMING
21.3000		STD DEV DS AT 4.0 MINUTE, FLAMING
276.2000		MAXIMUM SPECIFIC OPTICAL DENSITY, FLAMING
27.1000		STD DEV DMAX, FLAMING
10.8000	MIN	TIME TO MAXIMUM SPECIFIC OPTICAL DENSITY, FLAMING
-1.0000	MIN	STD DEV TIME TO DMAX, FLAMING

MAT ID	TEST METH CODE	TEST FAC CODE	DATA SOURCE CODE	TEST DATE	INTEGER OF IDENTIFICATION
BWP016	T03	BO		5/25/1978	1520

TEST PROCEDURE: NBS SMOKE CHAMBER: CONCENTRATION OF EVOLVED GASES
TEST REPORT NUMBER: BMT 78-900
MISCELLANEOUS NOTES:

TEST RESULT	UNIT OF MEASURE	TEST RESULT NAME
135.0000	PARTS/MILLION	CARBON MONOXIDE, FLAMING
0.0000	PARTS/MILLION	OXIDES OF NITROGEN, FLAMING
0.0000	PARTS/MILLION	HYDROGEN FLUORIDE, FLAMING
17.0000	PARTS/MILLION	HYDROGEN CHLORIDE, FLAMING
2.0000	PARTS/MILLION	HYDROGEN CYANIDE, FLAMING
0.0000	PARTS/MILLION	SULFUR DIOXIDE, FLAMING
-1.0000	PARTS/MILLION	CARBON MONOXIDE, SMOLDERING
-1.0000	PARTS/MILLION	OXIDES OF NITROGEN, SMOLDERING
-1.0000	PARTS/MILLION	HYDROGEN FLUORIDE, SMOLDERING
-1.0000	PARTS/MILLION	HYDROGEN CHLORIDE, SMOLDERING
-1.0000	PARTS/MILLION	HYDROGEN CYANIDE, SMOLDERING
-1.0000	PARTS/MILLION	SULFUR DIOXIDE, SMOLDERING

FIGURE 3. SAMPLE OF PRINT-OUT FORMAT NO. 2

3. ALTERNATIVES TO THE PRESENT SYSTEM OF DATA BANK OPERATION

As noted in section 2.2, the data bank is accessible only at TSC and to the contractor presently involved in updating the data bank. To obtain data on a material, an organization must contact the TSC data bank operator and request the desired data. Since the existence of the bank is not widely known this arrangement has tended to limit its usefulness to a small sector of the technical community. This section identifies the available alternatives to improve the data bank's utility and also presents the advantages and disadvantages associated with each alternative.

3.1 GENERAL DISCUSSION

The majority of materials data contained in the data bank concerns information on materials common to all transportation modes and is not limited to transit systems. As such, the data bank is of value to the modal administrations. Other organizations may also find the data bank of use, since many of the materials are used in various sectors of society. At present the data bank usage is limited, as little effort has been made to publicize its existence. If expanded access to the bank is desired, an effort must be made to introduce potential users to the system via technical reports and announcements in NTIS, the Federal Register, Trade Journal and presentations at meetings and conferences.

3.2 THE PRESENT SYSTEM

The user contacts TSC personnel who access the data base and provide the requested information at no charge to the user.

3.2.1 Advantages

a) Routine updating and maintenance of the data bank is easily accomplished and assures that the most recent data is provided to the user.

b) Data are available on the frequency of data bank use, identity of user and type of data requested.

c) Data additions and deletions performed only at TSC insure security of data in the data bank.

3.2.2 Disadvantages

a) A high frequency of requests for data could involve a considerable investment of UMTA funds for staff and computer time to respond to the information and data requests. Although the expected number of requests cannot at present be estimated, it is possible that one labor year of effort would be required.

b) The cost of providing data on request may result in the need to impose user charges which may decrease data bank usage and require the additional effort of setting up a bookkeeping system.

3.3 OPERATIONAL ALTERNATIVES

3.3.1 Access from Outside Terminals on "Read Only" Basis

With this alternative, any organization having the data bank telephone number, a compatible computer terminal and the appropriate password, could access the data bank directly. Such an arrangement would be on a "Read Only" basis where the user cannot add or delete any data in the data bank. This alternative would require that TSC only update and maintain the data bank, a task requiring a minimum level of effort. The cost to UMTA of such an arrangement will be dependent on the number of user requests.

3.3.1.1 Advantages

a) The expected cost to UMTA of the data bank operation may be decreased as TSC personnel will not be required to respond to all requests from users. Additional costs for computer time may increase if requests to the computer are substantial. These additional costs could be billed to the user.

b) For a properly equipped and knowledgeable user, this arrangement would provide a rapid response to requests and would be very convenient.

3.3.1.2 Disadvantages

a) The user must acquire the necessary terminal hardware and train personnel in the hardware usage and the DEC 1022 software program.

b) The cost to the user of acquiring the terminal hardware and understanding of the software program may not be justified if their usage rate is limited.

c) UMTA costs for computer time will increase if user demands are substantial and not billed to user.

3.3.2 Requested Data Provided by TSC Transportation Information Division

This option could be designed to handle routine requests for information on a "charge-for-data" basis. In general, the funds collected would provide for a pay-as-you-go program.

3.3.2.1 Advantages

a) The data bank would, with the exception of updating and maintenance, be largely self-supporting.

b) Records identifying users, access frequencies and specific costs (connect time, disc access and search time) could be well documented and easily maintained.

3.3.2.2 Disadvantages

This alternative could possibly discourage potential users outside the transit community.

3.3.3 Cost Sharing with Other DOT Administrations

As noted in Section 3.1, the information in the materials data bank is applicable to all DOT agencies and their respective industries. Furthermore, the materials data bank is the only DOT data bank containing information on the flammability, smoke and toxicity characteristics of transportation materials. This alternative is directed at having all the DOT agencies participate in sharing the costs associated with maintaining the data bank. As such, all agencies and their respective industries would have access to and provide input for the data bank.

3.3.3.1 Advantages

a) UMTA's cost to support the data bank would be minimized.

b) Sharing with the other DOT agencies would encourage and enhance the usage and overall value of the data bank.

This alternative would promote UMTA's technology-sharing image.

3.3.3.2 Disadvantages

a) The data bank will not be directed solely to the transit community.

b) Any future data bank changes which UMTA desires may pose problems for other DOT agencies.

3.3.4 Combination with Another System

This alternative is directed at incorporating the materials data bank into another existing materials data bank or system. A search was recently made to seek out other materials data banks in both government and industry with the objective of a mutual exchange of information. The few data banks that were found were of two types:

a) Those that contain only reference to technical journals, articles, and reports containing pertinent data.

b) Those that contain only materials' physical properties data.

Data banks of the first type are cumbersome. They contain lists of documents, sometimes with short abstracts, with information on a particular type of material. One has to obtain these documents, cull them for the pertinent information, and then assemble the individual data into some meaningful arrangement.

The only data banks found of the second type were UMTA's and those at the NASA Johnson Space Center (JSC). These data banks store materials data in various categories, including manufacturer, trade name, application, material type, material composition source of data, and the results of a wide variety of test procedures. Data can be retrieved in any manner permitted by the software program.

The data sorted at JSC are not useful to the transit community for two reasons:

1) The test methods were developed by NASA and are used only by NASA. They differ from other standard test methods, and it is impossible to use a correlation factor.

2) The tests are made at other than normal atmospheric pressure and at oxygen concentrations that differ from atmospheric.

Although there is no totally compatible data bank or system with which the UMTA data bank may be combined, this alternative is still put forth as a possibility.

3.3.4.1 Advantages

a) The present operational costs to UMTA would be reduced and possibly eliminated.

b) Data response time to the user could be reduced.

c) Potentially, more materials data would be available to the transit community.

3.3.4.2 Disadvantages

a) May limit UMTA involvement in future changes to materials data bank.

b) The difficulty in identifying and modifying the appropriate data bank or system with which to combine the materials data bank.

c) If the data bank or system is accessed only from outside facilities, the disadvantages identified in Sections 3.3.1.1 and 3.3.1.2 will apply.

3.3.5 Periodic Publication of Data

This alternative is designed to reach the largest segment of the technical community by periodically publishing the data bank information through the National Technical Information Service (NTIS). The report format would be in the form shown in Figure 2. To limit the size of the report, there would be several volumes, each containing the available data on a specific component category or application (i.e., carpet material). Updated information could be provided to users to supplement the periodic publications.

3.3.5.1 Advantages

a) This alternative would eliminate the need for users to contact TSC for data. UMTA costs would be reduced.

b) All the materials information of a specific component application will be available in a single document.

c) NTIS has a wide distribution and as such would provide a wide distribution for the data bank information.

3.3.5.2 Disadvantages

a) NTIS charges a nominal fee for each report. Users desiring only a small portion of the information on a specific component will be required to obtain the entire report.

b) Users would not be aware of data additions or deletions made between publication dates.

3.3.6 Discontinuation of Data Bank

3.3.6.1 Advantages

This alternative would eliminate the need for UMTA to support this segment of the Fire Safety in Transit Systems Program.

3.3.6.2 Disadvantages

The flammability and other physical characteristics of materials of interest, particularly to the modal administrations, would no longer be made available in a computerized fashion.

4. RECOMMENDATIONS

It is recommended that the alternative described in Section 3.3.2, "Requested Data Provided by TSC's Transportation Information Division" is the best method for managing and disseminating the information in the computerized materials data bank. This recommendation will be implemented by publishing in the Federal Register a notice of the availability of the data bank and the organizational contact at TSC with a telephone number and mailing address for obtaining additional information, or for obtaining information for specific materials applications. A minimum nominal fee will be charged for materials information.

APPENDIX

LIST OF TESTS AND MEASUREMENTS

A01	ASTM D1002: STRENGTH OF ADHESIVES IN SHEAR
A01A	NUMBER OF SPECIMENS
A01B	FAILURE LOAD
A01C	STD DEV FAILURE LOAD
A02	ASTM D882: TENSILE PROPS. OF THIN PLASTIC SHEETING
A02A	NUMBER OF SPECIMENS
A02B	RATE OF HEAD MOVEMENT
A02C	SPECIMEN LENGTH
A02D	SPECIMEN WIDTH
A02E	SPECIMEN THICKNESS
A02F	TENSILE STRENGTH
A02G	STD DEV TENSILE STRENGTH
A02H	TENSILE STRENGTH AT BREAK
A02I	ELONGATION AT BREAK
A02J	YIELD STRENGTH
A02K	ELONGATION AT BREAK
A02L	ELASTIC MODULUS
A04	ASTM D1876: PEEL RESTNCE OF ADHESVES (T-PEEL TEST)
A04A	NUMBER OF SPECIMENS-WARP
A04B	T-PEEL STRENGTH-WARP
A04C	STD DEV T-PEEL STRENGTH-WARP
A04D	NUMBER OF SPECIMENS-FILL
A04E	T-PEEL STRENGTH-FILL
A04F	STD DEV T-PEEL STRENGTH-FILL
A05	FTMS 191, METHOD 5850: OVEN AGING OF CLOTH
A05A	NUMBER OF SPECIMENS
A05B	BREAKING STRENGTH CHANGE
A05C	STD DEV BREAKING STRENGTH CHANGE
A06	ASTM D638;TENSILE PROPERTIES OF PLASTICS
A06A	NUMBER OF SPECIMENS
A06B	TENSILE STRENGTH
A06C	STD DEV TENSILE STRENGTH
A06D	TENSILE MODULUS
A06E	STD DEV TENSILE MODULUS
A06F	ULTIMATE ELONGATION
A06G	STD DEV ULTIMATE ELONGATION
B02	FTMS 191, METH 5122: STRENGTH OF CLOTH, DIAPH BRST
B02A	NUMBER OF SPECIMENS
B02B	BURST STRENGTH
B02C	STD DEV BURST STRENGTH
B03	FTMS 191, METH 5120: STRENGTH OF CLOTH, BALL BURST
B03A	NUMBER OF SPECIMENS
B03B	BURSTING STRENGTH
B03C	STD DEV BURSTING STRENGTH
B04	FTMS 191, METH 5304.1: WYZENBEEK ABRASION TEST
B04A	NUMBER OF SPECIMENS
B04B	LOSS OF STRENGTH IN WARP/ISOTROPIC DIRECTION
B04C	STD DEV LOSS OF STRENGTH IN WARP/ISOTRPC DIRECTION
B04D	LOSS OF STRENGTH IN FILL DIRECTION
B04E	STD DEV LOSS OF STRENGTH IN FILL DIRECTION

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B05    ASTM D1682: LOAD & ELNGATN OF TXTILE FABRICS
B05A   NUMBER OF SPECIMENS-WARP
B05B   BREAKING LOAD-WARP
B05C   STD DEV BREAKING LOAD-WARP
B05D   APPARENT ELONGATION-WARP
B05E   STD DEV APPARENT ELONGATION-WARP
B05F   NUMBER OF SPECIMENS-FILL
B05G   BREAKING LOAD-FILL
B05H   STD DEV BREAKING LOAD-FILL
B05I   APPARENT ELONGATION-FILL
B05J   STD DEV APPARENT ELONGATION-FILL
B06    ASTM D1683: SEAM BREAKING STRNGTH OF WOVEN FABRICS
B06A   NUMBER OF SPECIMENS-WARP
B06B   BREAKING LOAD-WARP
B06C   STD DEV BREAKING LOAD-WARP
B06D   NUMBER OF SPECIMENS-FILL
B06E   BREAKING LOAD-FILL
B06F   STD DEV BREAKING LOAD-FILL
B11    ASTM D2136: COATED FABRICS-LOW TEMPRTURE BEND TEST
B11A   NUMBER OF SPECIMENS
B11B   EXPOSURE TEMPERATURE
B11C   EXPOSURE TIME
B11D   TEST RESULT      (1=PASS: 0=FAIL)
C01    ASTM D395-69: COMPRESSION SET OF RUBBER
C01A   NUMBER OF SPECIMENS
C01B   SPECIMEN THICKNESS, ORIGINAL
C01C   SPECIMEN DIAMETER, ORIGINAL
C01D   HEAT TREATMENT TIME
C01E   HEAT TREATMENT TEMPERATURE
C01F   COMPRESSION SET, CONSTANT LOAD
C01G   STD DEV COMPRESSION SET, CONSTANT LOAD
C01H   COMPRESSION SET, CONSTANT DEFLECTION
C01I   STD DEV COMPRESSION SET, CONSTANT DEFLECTION
C02    ASTM D412: PROPERTIES OF RUBBER IN TENSION
C02A   NUMBER OF SPECIMENS
C02B   SPECIMEN THICKNESS
C02C   TENSILE STRENGTH
C02D   STD DEV TENSILE STRENGTH
C02E   ULTIMATE ELONGATION
C02F   STD DEV ULTIMATE ELONGATION
C02G   TENSILE SET AT 200% ELONGATION
C02H   STD DEV TENSILE SET AT 200% ELONGATION
C03    ASTM D624: TEAR RESISTANCE OF RUBBER
C03A   NUMBER OF SPECIMENS
C03B   SPECIMEN THICKNESS
C03C   TEAR RESISTANCE
C03D   STD DEV TEAR RESISTANCE
C03E   TEAR RESISTANCE PER ISO/R34
C03F   STD DEV TEAR RESISTANCE PER ISO/R34
C05    FTMS 406, METHOD 1021: CMPRSSV PROPS RIGID PLASTCS
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C05A	NUMBER OF SPECIMENS - WARP
C05B	COMPRESSIVE STRENGTH - WARP
C05C	STD DEV COMPRESSIVE STRENGTH - WARP
C05D	COMPRESSIVE MODULUS - WARP
C05E	STD DEV COMPRESSIVE MODULUS - WARP
C05F	NUMBER OF SPECIMENS - FILL
C05G	COMPRESSIVE STRENGTH - FILL
C05H	STD DEV COMPRESSIVE STRENGTH - FILL
C05I	COMPRESSIVE MODULUS - FILL
C05J	STD DEV COMPRESSIVE MODULUS - FILL
C06	ASTM C366: MEAS. OF THICKNESS OF SANDWICH CORES
C06A	THICKNESS
C06B	STD DEV THICKNESS
C09	ASTM D695: COMPRESSIVE PROPERTIES OF RIGID PLASTCS
C09A	NUMBER OF SPECIMENS
C09B	RATE OF HEAD MOVEMENT
C09C	SPECIMEN LENGTH
C09D	SPECIMEN WIDTH
C09E	SPECIMEN THICKNESS
C09F	COMPRESSIVE STRENGTH
C09G	STD DEV COMPRESSIVE STRENGTH
C09H	COMPRESSIVE YIELD STRENGTH
C09I	STD DEV COMPRESSIVE YIELD STRESS
C09J	OFFSET YIELD STRESS
C09K	MODULUS OF ELASTICITY
C09L	STD DEV MODULUS OF ELASTICITY
C12	ASTM D1621:COMPRESSIVE PROPS OF RGD CELLULR PLASTC
C12A	NUMBER OF SPECIMENS
C12B	COMPRESSIVE STRENGTH
C12C	STD DEV COMPRESSIVE STRENGTH
C12D	COMPRESSIVE MODULUS
C12E	STD DEV COMPRESSIVE MODULUS
C12F	DEFORMATION
C12G	STD DEV DEFORMATION
C18	ASTM D575: PROPERTIES OF RUBBER IN COMPRESSION
C18A	NUMBER OF SPECIMENS
C18B	COMPRESSION DEFLECTION
C18C	STD DEV COMPRESSION DEFLECTION
C18D	COMPRESSION FORCE
C18E	STD DEV COMPRESSION FORCE
C19	ASTM D1564: FLEXBL CELLULR MATLS-SLAB URETHNE FOAM
C19A	NUMBER OF SPECIMENS
C19B	DENSITY
C19C	STD DEV DENSITY
C19D	COMPRESSION SET
C19E	STD DEV COMPRESSION SET
C19F	IMPACT RESILIENCE, PERCENT REBOUND
C19G	STD DEV IMPACT RESILIENCE, PERCENT REBOUND
C19H	COMPRESSIVE STRESS FOR 25% DEFLECTION
C19I	COMPRESSIVE STRESS FOR 50% DEFLECTION

C21	AATCC TEST METH. 16E-1977: COLORFASTNESS TO LIGHT	
C21A	NUMBER OF SPECIMENS	
C21B	GRAY SCALE COLOR CHANGE	
C22	AATCC TEST METH. 8-1977: COLORFASTNESS TO CROCKING	
C22A	NUMBER OF SPECIMENS	
C22B	GRAY SCALE COLOR CHANGE	
CH1	GENERAL RESISTANCE TO CHEMICALS	
CH1A	STRONG ACIDS	(-1=UNKNWN,0=RST TO,1=ATTACKED BY)
CH1B	WEAK ACIDS	(-1=UNKNWN,0=RST TO,1=ATTACKED BY)
CH1C	STRONG ALKALI	(-1=UNKNWN,0=RST TO,1=ATTACKED BY)
CH1D	WEAK ALKALI	(-1=UNKNWN,0=RST TO,1=ATTACKED BY)
CH1E	WATER	(-1=UNKNWN,0=RST TO,1=ATTACKED BY)
CH1F	KETONES & ESTERS	(-1=UNKNWN,0=RST TO,1=ATTACKED BY)
CH1G	ALCOHOLS	(-1=UNKNWN,0=RST TO,1=ATTACKED BY)
CH1H	HYDROCRBN SLVNTS	(-1=UNKNWN,0=RST TO,1=ATTACKED BY)
CH1I	CL HYDCBN SLVNTS	(-1=UNKNWN,0=RST TO,1=ATTACKED BY)
CH1J	PHENOLS	(-1=UNKNWN,0=RST TO,1=ATTACKED BY)
CH1K	LUBRICATING OILS	(-1=UNKNWN,0=RST TO,1=ATTACKED BY)
CH1L	SEE MISC NOTES	(-1=UNKNWN,0=RST TO,1=ATTACKED BY)
D01	ASTM D2440: RUBBER PROPERTY - DUROMETER HARDNESS	
D01A	NUMBER OF SPECIMENS	
D01B	DUROMETER HARDNESS	
D01C	STD DEV DUROMETER HARDNESS	
D03	ASTM D297: SPECIFIC GRAVITY OF RUBBER PRODUCTS	
D03A	NUMBER OF SPECIMENS	
D03B	SPECIFIC GRAVITY	
D03C	STD DEV SPECIFIC GRAVITY	
D04	FTMS 406, METHOD 5012: SPECIFIC GRAVITY, WT & VOLM	
D04A	NUMBER OF SPECIMENS	
D04B	SPECIFIC GRAVITY	
D04C	STD DEV SPECIFIC GRAVITY	
D05	ASTM D792: SPECIFIC GRAVITY AND DENSITY OF PLASTCS	
D05A	NUMBER OF SPECIMENS	
D05B	SPECIFIC GRAVITY	
D05C	STD DEV SPECIFIC GRAVITY	
D05D	DENSITY	
D05E	STD DEV DENSITY	
D08	DIMENSIONAL STABILITY OF TEXTILES ON CLEANING	
D08A	NUMBER OF SPECIMENS	
D08B	DIMENSIONAL CHANGE - WARP/WALE	
D08C	STD DEV DIMENSIONAL CHANGE - WARP/WALE	
D08D	DIMENSIONAL CHANGE - FILL/COURSE	
D08E	STD DEV DIMENSIONAL CHANGE - FILL/COURSE	
D09	ASTM D648: TEMPERATURE OF DEFLECTION ONSET, PLSTCS	
D09A	NUMBER OF SPECIMENS	
D09B	FLEXURAL LOAD	
D09C	DEFLECTION TEMPERATURE	
D09D	STD DEV DEFLECTION TEMPERATURE	
E02	FTMS 191, METH 5100.1: STRNGTH OF CLOTH; GRAB METH	
E02A	NUMBER OF SPECIMENS - WARP	

E02B BREAKING STRENGTH - WARP
E02C STD DEV BREAKING STRENGTH - WARP
E02D ELONGATION - WARP
E02E STD DEV ELONGATION - WARP
E02F NUMBER OF SPECIMENS - FILL
E02G BREAKING STRENGTH - FILL
E02H STD DEV BREAKING STRENGTH - FILL
E02I ELONGATION - FILL
E02J STD DEV ELONGATION - FILL
E04 ASTM D696: LINEAR THERML EXPNSN COEFF. OF PLASTICS
E04A NUMBER OF SPECIMENS
E04B COEFFICIENT OF LINEAR THERMAL EXPANSION
E04C STD DEV COEFFICIENT OF LINEAR THERMAL EXPANSION
F00 FEDERAL AIR REGULATION 25, VERTICAL TESTS
F00A IGNITION TIME
F00B SELF-EXTINGUISHING TIME, ISOTROPIC/WARP
F00C BURNED LENGTH, ISOTROPIC/WARP
F00D DRIP EXTINGUISHING TIME, ISOTROPIC/WARP
F00E SELF EXTINGUISHING TIME, FILL
F00F BURNED LENGTH, FILL
F00G DRIP EXTINGUISHING TIME, FILL
F01 FEDERAL AIR REGULATIONS 25, NON-VERTICAL TESTS
F01A SELF-EXTINGUISHNG TIME, HZNTL TEST,ISOTROPIC/WARP
F01B BURNED LENGTH, HZNTL TEST, ISOTROPIC/WARP
F01C BURNING RATE, HZNTL TEST, ISOTROPIC/WARP
F01D SELF-EXTINGUISHING TIME, HZNTL TEST, FILL
F01E BURNED LENGTH, HZNTL TEST, FILL
F01F BURNING RATE, HZNTL TEST, FILL
F01G AFTER-GLOW TIME, 45 DEGREE TEST
F01H FLAME PENETRATION, 45 DEGREE TEST (0=NO, 1=YES)
F02 ASTM D 350:FLAMM FLEX TREATD ELEC INSULATN SLEEVNG
F02A TIME TO BURN A LENGTH OF ONE INCH
F03 ASTM D 568: FLAMMABILITY OF FLEXIBLE PLASTICS
F03A MATERIAL THICKNESS
F03B BURNING RATE
F03C SELF-EXTINGUISHING TIME
F03D DISTANCE BURNED
F03E PRESENCE OF BURNING DROPS (-1=UNKNOWN,0=NO,1=YES)
F04 ASTM D 635: FLAMM. OF SELF-SUPPORTING PLASTICS
F04A MATERIAL THICKNESS
F04B BURNING RATE
F04C SELF-EXTINGUISHING TIME
F04D DISTANCE BURNED
F04E PRESENCE OF BURNING DROPS (-1=UNKNOWN,0=NO,1=YES)
F05 ASTM D 757: FLAMM. OF PLASTICS,SELF-EXTNGSHNG TYPE
F05A BURNING RATE
F05B BURNING TIME
F05C OCCURRENCE OF MELTING OR BURNING DROPS(0=NO,1=YES)
F06 ASTM D 777: FLAMM. OF TREATED PAPER AND PAPERBOARD
F06A CHAR LENGTH

F06B	DURATION OF AFTERGLOW
F07	ASTM D 1230: FLAMMABILITY OF CLOTHING TEXTILES
F07A	FLAMMABILITY CLASS
F08	ASTM D 1433: FLAMM. OF FLEX. THIN PLASTIC SHEETING
F08A	MATERIAL THICKNESS
F08B	BURNING RATE
F08C	PRESENCE OF BURNING DROPS (0=NO,1=YES)
F09	ASTM D 1929:IGNITION PROPS OF PLASTICS(SETCHKIN)
F09A	FLASH IGNITION TEMPERATURE
F09B	SELF-EXTINGUISHING TEMPERATURE
F10	ASTM D 2859: FLAMM. OF TEXTL FLOOR COVERING MATLS
F10A	NUMBER OF 8 SPECIMENS RESISTANT TO FLAMMABILITY
F11	ASTM D 2863:FLAMM. OF PLASTICS,OXYGEN INDEX METHOD
F11A	NUMBER OF SPECIMENS
F11B	OXYGEN INDEX
F11C	STANDARD DEVIATION - OXYGEN INDEX
F12	ASTM D 69:COMBUSTBLE PROPS OF TRTD WOOD,FIRE-TUBE
F12A	MOISTURE CONTENT OF MATERIAL
F12B	WEIGHT LOSS OF MATERIAL AFTER BURNING HAS CEASED
F13	ASTM E 84: SURFACE BURNING CHARACTERISTICS OF MATL
F13A	FLAME SPREAD CLASSIFICATION - DISTANCE
F13B	FLAME SPREAD CLASSIFICATION - FUEL CONTRIBUTION
F13C	FLAME SPREAD CLASSIFICATION - SMOKE CONTRIBUTION
F14	ASTM E 162:MATL SURFACE FLAMM USING RADIANT ENERGY
F14A	MATERIAL THICKNESS
F14B	NUMBER OF SPECIMENS
F14C	FLAME SPREAD FACTOR FS
F14D	STANDARD DEVIATION OF FLAME SPREAD FACTOR FS
F14E	HEAT EVOLUTION FACTOR Q
F14F	STANDARD DEVIATION OF HEAT EVOLUTION FACTOR Q
F14G	FLAME SPREAD INDEX IS
F14H	STANDARD DEVIATION OF FLAME SPREAD INDEX IS
F15	ASTM E 286: SURFC FLAMM OF BLDNG MATLS,8-FT TUNNEL
F15A	FLAME SPREAD INDEX
F15B	FUEL CONTRIBUTED INDEX
F15C	SMOKE DENSITY INDEX
F16	FTMS 191, METHOD 5900: FLAME RES. OF CLOTH; HZNTL
F16A	FLAME RESISTANCE
F17	FTMS 191, METHOD 5903: FLAME RES. OF CLOTH; VRTCL
F17A	AFTER-FLAME TIME
F17B	AFTER-GLOW TIME
F17C	CHAR LENGTH
F18	FTMS 191, METHOD 5905:FLAME RES OF MATL;HIGH HEAT
F18A	REACTION OF MATERIAL TO FLAME:SEE USER'S MANUAL
F19	FTMS 191, METHOD 5906: BURNING RATE OF CLOTH;HZNTL
F19A	BURNING RATE
F20	FTMS 191, METHOD 5908:BURNING RATE OF CLOTH;45 DEG
F20A	FLAMMABILITY
F21	OHIO STATE UNIV RELEASE RATE APPARATUS,FLAMMABILITY
F21A	THERMAL FLUX

F21B AIR FLOW
F21C MATERIAL THICKNESS
F21D ORIENTATION (-1=UNKNOWN,0=VERTICAL,1=HORIZONTAL)
F21E IGNITION (-1=UNKNOWN,0=NON-PILOTED,1=PILOTED)
F21F SLOPE E
F21H TIME TO MAXIMUM HEAT RELEASE RATE
F21I HEAT RELEASED AFTER 4 MINUTES
F21J TOTAL HEAT RELEASED
F22 NBS RADIANT PANEL FLOORING TEST
F22A MATERIAL THICKNESS
F22B CRITICAL RADIANT FLUX
F22C STANDARD DEVIATION, CRITICAL RADIANT FLUX
F22D NUMBER OF SPECIMENS TESTED
F23 FLAMMABILITY TEST FOR ELECTRICAL WIRE
F23A TIME TO IGNITION, VERTICAL
F23B TIME TO IGNITION, HORIZONTAL
F23C AFTER FLAME/GLOW TIME, VERTICAL
F23D AFTER FLAME/GLOW TIME, HORIZONTAL
F23E FLAME DAMAGE LENGTH, VERTICAL
F23F FLAME DAMAGE LENGTH, HORIZONTAL
F23G CONVEY FLAME, VERTICAL (0=NO;1=YES)
F23H CONVEY FLAME, HORIZONTAL (0=NO;1=YES)
F23I POST FLAME DIELECTRIC (VOLTS)
F24 ASTM E-119: FIRE TESTS OF BUILDING CONSTRUCTION AN
F24A RESULTS (0=FAIL;1=PASS)
F25 ASTM D 3675:MTL SURFACE FLAMM USING RADIANT ENERGY
F25A MATERIAL THICKNESS
F25B NUMBER OF SPECIMENS
F25C FLAME SPREAD FACTOR FS
F25D STANDARD DEVIATION OF FLAME SPREAD FACTOR FS
F25E HEAT EVOLUTION FACTOR Q
F25F STANDARD DEVIATION OF HEAT EVOLUTION FACTOR Q
F25G FLAME SPREAD INDEX IS
F25H STANDARD DEVIATION OF FLAME SPREAD INDEX IS
G03 ASTM D523: SPECULAR GLOSS
G03A NUMBER OF SPECIMENS
G03B 20 DEGREE GLOSS
G03C STD DEV 20 DEGREE GLOSS
G03D 60 DEGREE GLOSS
G03E STD DEV 60 DEGREE GLOSS
G03F 85 DEGREE GLOSS
G03G STD DEV 85 DEGREE GLOSS
G04 ASTM C177: THERMAL CONDUCTIVITY BY GUARDED PLATE
G04A THERMAL CONDUCTIVITY
G04B STD DEV THERMAL CONDUCTIVITY
G05 ASTM C273: SHEAR PROPS. OF FLAT SANDWICH CONSTCTNS
G05A NUMBER OF SPECIMENS
G05B SHEAR STRENGTH
G05C STD DEV SHEAR STRENGTH
G05D ULTIMATE SHEAR STRAIN

G05E STD DEV ULTIMATE SHEAR STRAIN
G05F SHEAR MODULUS
G05G STD DEV SHEAR MODULUS
G06 HIGH TMPTURE (180F) RSTNCE FOR POLYMR COATED FABRC
G06A NUMBER OF SPECIMENS
G06B TACKINESS, EMBRITTLEMENT, PUNGENT ODOR (1=YES;0=NO
I03 ASTM D2444: IMPACT RSTNCE OF PLASTIC PIPE USNG TUP
I03A NUMBER OF SPECIMENS
I03B IMPACT RESISTANCE
I03C STD DEV IMPACT RESISTANCE
I04 ASTM D256: IMPACT RESISTANCE OF PLASTICS
I04A IZOD IMPACT STRENGTH
I04B STD DEV IZOD IMPACT STRENGTH
I05 ASTM D2583: INDENTATION HARDNSS OF PLASTCS, BARCOL
I05A NUMBER OF SPECIMENS
I05B BARCOL HARDNESS
I05C STD DEV BARCOL HARDNESS
I08 ASTM D3029: IMPACT RSTNCE OF PLASTC SHEET USNG TUP
I08A NUMBER OF SPECIMENS
I08B SPECIMEN THICKNESS
I08C IMPACT RESISTANCE
I08D STD DEV IMPACT RESISTANCE
L01 MIL-STD-401B: FLEXURAL PROPS OF SANDWCH CONSTRCTNS
L01A NUMBER OF SPECIMENS
L01B CORE SHEAR STRESS
L01C STD DEV CORE SHEAR STRESS
L01D FACING STRESS
L01E STD DEV FACING STRESS
L01F P/Y - INITIAL SLOPE OF LOAD/DEFLECTION CURVE
L01G STD DEV P/Y-INITIAL SLOPE OF LOAD/DEFLECTION CURVE
L01H CORE SHEAR MODULUS
L01I STD DEV CORE SHEAR MODULUS
L03 MIL-STD-401B: PEEL STRENGTH OF SANDWICH CONSTRCTNS
L03A NUMBER OF SPECIMENS
L03B PEEL STRENGTH
L03C STD DEV PEEL STRENGTH
L07 MIL-STD-401B: TENSILE STRENGTH OF SNDWCH CNSTRCTNS
L07A NUMBER OF SPECIMENS
L07B TENSILE STRENGTH
L07C STD DEV TENSILE STRENGTH
M01 FTMS 406, METHOD 1011: TENSILE PROPRTS OF PLASTICS
M01A NUMBER OF SPECIMENS - WARP/ISOTROPIC
M01B TENSILE STRENGTH - WARP/ISOTROPIC
M01C STD DEV TENSILE STRENGTH - WARP/ISOTROPIC
M01D ELONGATION - WARP/ISOTROPIC
M01E STD DEV ELONGATION - WARP/ISOTROPIC
M01F ELASTIC MODULUS - WARP/ISOTROPIC
M01G NUMBER OF SPECIMENS - FILL
M01H TENSILE STRENGTH - FILL
M01I STD DEV TENSILE STRENGTH - FILL

M01J ELONGATION - FILL
M01K STD DEV ELONGATION - FILL
M01L ELASTIC MODULUS - FILL
M02 FTMS 406, METHOD 1031: FLEXURAL PROPTS OF PLASTICS
M02A NUMBER OF SPECIMENS - WARP
M02B FLEXURAL STRENGTH - WARP
M02C STD DEV FLEXURAL STRENGTH - WARP
M02D FLEXURAL MODULUS - WARP
M02E STD DEV FLEXURAL MODULUS - WARP
M02F NUMBER OF SPECIMENS - FILL
M02G FLEXURAL STRENGTH - FILL
M02H STD DEV FLEXURAL STRENGTH - FILL
M02I FLEXURAL MODULUS - FILL
M02J STD DEV FLEXURAL MODULUS - FILL
M03 ASTM D790: FLEXURAL PROPERTIES OF PLASTICS
M03A NUMBER OF SPECIMENS
M03B MAXIMUM FIBER STRESS
M03C STD DEV MAXIMUM FIBER STRESS
M03D FLEXURAL STRENGTH
M03E STD DEV FLEXURAL STRENGTH
M03F FLEXURAL YIELD STRESS
M03G STD DEV FLEXURAL YIELD STRESS
M03H FLEXURAL OFFSET YIELD STRESS
M03I STD DEV FLEXURAL OFFSET YIELD STRESS
M03J TANGENT MODULUS OF ELASTICITY
M03K STD DEV TANGENT MODULUS OF ELASTICITY
M03L SECANT MODULUS OF ELASTICITY
M04 FTMS 191, METHOD 5134: TEARING STRENGTH OF CLOTH
M04A NUMBER OF SPECIMENS - WARP
M04B TEARING STRENGTH - WARP
M04C STD DEV TEARING STRENGTH - WARP
M04D NUMBER OF SPECIMENS
M04E TEARING STRENGTH - FILL
M04F STD DEV TEARING STRENGTH - FILL
M05 ASTM D3512: PILLING RSTNCE OF TXTILES-RANDM TUMBLR
M05A NUMBER OF SPECIMENS
M05B NUMBER OF PILLS
M05C STD DEV NUMBER OF PILLS
P01 PHYSICAL, MECHANICAL, AND ELECTRICAL PROPERTIES
P01A SPECIFIC GRAVITY
P01B THERMAL CONDUCTIVITY
P01C THERMAL EXPANSION COEFFICIENT
P01D TENSILE MODULUS
P01E COMPRESSIVE STRENGTH
P01F ULTIMATE TENSILE STRENGTH
P01G ULTIMATE ELONGATION
P01H IZOD NOTCHED IMPACT STRENGTH
P01I COMPRESSION SET, FLEXIBLE FOAMS AFTER 22 HRS,158F
P01J DIELECTRIC STRENGTH
P01K DIELECTRIC CONSTANT AT 60 CYCLES/SEC

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P01L   DIELECTRIC CONSTANT AT 1,000,000 CYCLES/SEC
R03    ASTM D1329: RUBBER RETRACTION AT LOW TEMPERATURE
R03A   NUMBER OF SPECIMENS
R03B   SPECIMEN THICKNESS
R03C   TR 10
R03D   STD DEV TR 10
R03E   TR 30
R03F   STD DEV TR 30
R03G   TR 50
R03H   STD DEV TR 50
R03I   TR 70
R03J   STD DEV TR 70
R08    SNAG RESISTANCE OF TEXTILES
R08A   NUMBER OF SPECIMENS
R08B   NUMBER OF SNAGS
R08C   STD DEV NUMBER OF SNAGS
R14    ASTM D573: DETERIORATION OF RUBBER IN AN AIR OVEN
R14A   AGING TEMPERATURE
R14B   AGING TIME
R14C   DUROMETER HARDNESS
R14D   STD DEV DUROMETER HARDNESS
R14E   SPECIMEN THICKNESS FOR TENSILE PROPERTIES DETRMNTN
R14F   TENSILE STRENGTH
R14G   STD DEV TENSILE STRENGTH
R14H   ULTIMATE ELONGATION
R14I   STD DEV ULTIMATE ELONGATION
R14J   SPECIMEN THICKNESS FOR  COMPRESSION SET DETERMINAT
R14K   SPECIMEN DIAMETER FOR COMPRESSION SET DETERMINATN
R14L   COMPRESSION SET AT CONSTANT LOAD
S01    NFPA 258 (ASTM E662, NBS SMOKE CHAMBER)
S01A   MATERIAL THICKNESS
S01B   THERMAL FLUX OF HEATER
S01C   SPECIFIC OPTICAL DENSITY AT 1.5 MIN, FLAMING
S01D   SPECIFIC OPTICAL DENSITY AT 1.5 MIN, SMOLDERING
S01E   SPECIFIC OPTICAL DENSITY AT 4.0 MIN, FLAMING
S01F   SPECIFIC OPTICAL DENSITY AT 4.0 MIN, SMOLDERING
S01G   MAXIMUM SPECIFIC OPTICAL DENSITY, FLAMING
S01H   TIME TO MAXIMUM SPECIFIC OPTICAL DENSITY, FLAMING
S01I   MAXIMUM SPECIFIC OPTICAL DENSITY, SMOLDERING
S01J   TIME TO MAXIMUM SPECIFIC OPTICAL DENSITY, SMOLDRNG
S02    ASTM D 2843: SMOKE DENSITY FROM BURNING PLASTICS
S02A   MATERIAL THICKNESS
S02B   SMOKE DENSITY RATING
S03    SURFACE BURNING CHARACTERISTICS OF BURNING MATERIA
S03A   SMOKE CONTRIBUTION RELATIVE TO RED OAK
S04    OHIO STATE UNIVERSITY RELEASE RATE APPARATUS,SMOKE
S04A   THERMAL FLUX
S04B   AIR FLOW
S04C   MATERIAL THICKNESS
S04D   ORIENTATION    (-1=UNKNOWN;0=VERTICAL;1=HORIZONTAL)
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S04E	IGNITION (-1=UNKNOWN;0=NON-PILOTED;1=PILOTED)
S04F	SPECIFIC OPTICAL DENSITY AT 1.5 MINUTES
S04G	SPECIFIC OPTICAL DENSITY AT 4.0 MINUTES
S04H	MAXIMUM SPECIFIC OPTICAL DENSITY
S05	SMOKE EMISSION: NAFEC PROJECT USING NBS CHAMBER
S05A	TOTAL NUMBER OF SPECIMENS TESTED OF MATERIAL TYPE
S05B	NUMBER OF SPECIMENS SHOWING DMAX IN RANGE 0-16
S05C	NUMBER OF SPECIMENS SHOWING DMAX IN RANGE 16-30
S05D	NUMBER OF SPECIMENS SHOWING DMAX IN RANGE 30-70
S05E	NUMBER OF SPECIMENS SHOWING DMAX IN RANGE 70-100
S05F	NUMBER OF SPECIMENS SHOWING DMAX IN RANGE 100-200
S05G	NUMBER OF SPECIMENS SHOWING DMAX IN RANGE 200-300
S05H	NUMBER OF SPECIMENS SHOWING DMAX IN RANGE 300-400
S05I	NUMBER OF SPECIMENS SHOWING DMAX GREATER THAN 400
S05J	NUMBER OF SPECIMENS NOT REACHING D= 16 IN 90 SECS
S05K	NUMBER OF SPECIMENS NOT REACHING D=100 IN 90 SECS
S06	SMOKE EMISSION: NAFEC PROJECT USING XP2 CHAMBER
S06A	TOTAL NUMBER OF SPECIMENS TESTED OF MATERIAL TYPE
S06B	NUMBER OF SPECIMENS SHOWING PERCENT LA MAX 0-5
S06C	NUMBER OF SPECIMENS SHOWING PERCENT LA MAX 5-10
S06D	NUMBER OF SPECIMENS SHOWING PERCENT LA MAX 10-30
S06E	NUMBER OF SPECIMENS SHOWING PERCENT LA MAX 30-50
S06F	NUMBER OF SPECIMENS SHOWING PERCENT LA MAX 50-70
S06G	NUMBER OF SPECIMENS SHOWING PERCENT LA MAX 70-80
S06H	NUMBER OF SPECIMENS SHOWING PERCENT LA MAX 80-90
S06I	NUMBER OF SPECIMENS SHOWING PERCENT LA MAX 90-100
S06J	NR SPECIMENS NOT REACHING 10% LA MAX IN 90 SECS
S06K	NR SPECIMENS NOT REACHING 40% LA MAX IN 90 SECS
S11	NFPA 258 (ASTM E662, NBS SMOKE CHAMBER)
S11A	MATERIAL THICKNESS
S11B	THERMAL FLUX OF HEATER
S11C	SPECIFIC OPTICAL DENSITY AT 1.5 MINUTE, FLAMING
S11D	STD DEV DS AT 1.5 MINUTE, FLAMING
S11E	SPECIFIC OPTICAL DENSITY AT 4.0 MINUTE, FLAMING
S11F	STD DEV DS AT 4.0 MINUTE, FLAMING
S11G	MAXIMUM SPECIFIC OPTICAL DENSITY, FLAMING
S11H	STD DEV DMAX, FLAMING
S11I	TIME TO MAXIMUM SPECIFIC OPTICAL DENSITY, FLAMING
S11J	STD DEV TIME TO DMAX, FLAMING
T01	NBS SMOKE CHAMBER: MGRM TOXICANT EVOLVED/GRAM MATL
T01A	CARBON MONOXIDE, FLAMING
T01B	OXIDES OF NITROGEN, FLAMING
T01C	HYDROGEN FLUORIDE, FLAMING
T01D	HYDROGEN CHLORIDE, FLAMING
T01E	HYDROGEN CYANIDE, FLAMING
T01F	SULFUR DIOXIDE, FLAMING
T01G	CARBON MONOXIDE, SMOLDERING
T01H	OXIDES OF NITROGEN, SMOLDERING
T01I	HYDROGEN FLUORIDE, SMOLDERING
T01J	HYDROGEN CHLORIDE, SMOLDERING

T01K	HYDROGEN CYANIDE, SMOLDERING
T01L	SULFUR DIOXIDE, SMOLDERING
T02	TOXIC GAS EVOLUTION:SEE TEST NOTES FOR TEST METHOD
T02A	CARBON MONOXIDE
T02B	OXIDES OF NITROGEN
T02C	HYDROGEN FLUORIDE
T02D	HYDROGEN CHLORIDE
T02E	HYDROGEN CYANIDE
T02F	SULFUR DIOXIDE
T03	NBS SMOKE CHAMBER: CONCENTRATION OF EVOLVED GASES
T03A	CARBON MONOXIDE, FLAMING
T03B	OXIDES OF NITROGEN, FLAMING
T03C	HYDROGEN FLUORIDE, FLAMING
T03D	HYDROGEN CHLORIDE, FLAMING
T03E	HYDROGEN CYANIDE, FLAMING
T03F	SULFUR DIOXIDE, FLAMING
T03G	CARBON MONOXIDE, SMOLDERING
T03H	OXIDES OF NITROGEN, SMOLDERING
T03I	HYDROGEN FLUORIDE, SMOLDERING
T03J	HYDROGEN CHLORIDE, SMOLDERING
T03K	HYDROGEN CYANIDE, SMOLDERING
T03L	SULFUR DIOXIDE, SMOLDERING
V01	ASTM D903: PEEL STRENGTH OF ADHESIVE BONDS
V01A	PEEL STRENGTH-NYLON
V01B	STD DEV PEEL STRENGTH-NYLON
V01C	PEEL STRENGTH-MYLAR
V01D	STD DEV PEEL STRENGTH-MYLAR
V01E	PEEL STRENGTH AT ROOM TEMPERATURE
V01F	STD DEV PEEL STRENGTH AT ROOM TEMPERATURE
V01G	PEEL STRENGTH AT 120F AND 100% RELATIVE HUMIDITY
V01H	STD DEV PEEL STRENGTH AT 120F AND 100% RH
V01I	PEEL STRENGTH AT 160F
V01J	STD DEV PEEL STRENGTH AT 160F
W02	WEIGHT OF TEXTILES AND SHEET MATERIALS
W02A	NUMBER OF SPECIMENS
W02B	THICKNESS
W02C	STD DEV THICKNESS
W02D	AREAL DENSITY
W02E	STD DEV AREAL DENSITY
W02F	SPECIFIC GRAVITY
W02G	STD DEV SPECIFIC GRAVITY
W05	FTMS 406, METHOD 1091: TABER ABRASION TEST
W05A	NUMBER OF SPECIMENS
W05B	WEIGHT LOSS PER 1000 REVOLUTIONS
W05C	STD DEV WEIGHT LOSS PER 1000 REVOLUTIONS
W07	ASTM D756: WEIGHT AND SHAPE CHANGES OF PLASTICS
W07A	NUMBER OF SPECIMENS
W07B	WEIGHT CHANGE
W07C	STD DEV WEIGHT CHANGE
W07D	LENGTH CHANGE

W07E	STD DEV LENGTH CHANGE
W07F	WIDTH CHANGE
W07G	STD DEV WIDTH CHANGE
W07H	THICKNESS CHANGE
W07I	STD DEV THICKNESS CHANGE
W08	ASTM D570: WATER ABSORPTION BY PLASTICS
W08A	NUMBER OF SPECIMENS
W08B	WATER ABSORPTION
W08C	STD DEV WATER ABSORPTION
W21	FTMS 406, METHOD 7031: WATER ABSORPTION BY PLASTCS
W21A	NUMBER OF SPECIMENS
W21B	WATER ABSORPTION
W21C	STD DEV WATER ABSORPTION

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